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ROCKY FLATS PLANT, P.O. BOX 464, GOLDEN, COLORADO 80402-0464 • (303) 966-7000

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J. M. Roberson
Acting Assistant Manager for
Environmental Restoration
DOE, RFO

Attn: V. F. Witherill

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TRANSMITTAL OF SECOND RISK ASSESSMENT FOR OPERABLE UNIT 2 (WATER TREATMENT FACILITY) RELEASE TO THE ENVIRONMENT - SGS-210-94

Ref: G. W. Baughman ltr to R. J. Schassburger, Risk Posed by Spill at the OU2 Field Treatability Unit, February 11, 1994

Attached for transmittal to the Colorado Department of Health (CDH) is the second Risk Assessment for the December 4, 1993 release of approximately ten gallons of water from the Operable Unit 2 (OU2) water treatment facility.

As directed by CDH, the attached Risk Assessment has effectively re-evaluated the risk for this release using further guidance from CDH. Specifically, this risk assessment methodology comprises the spreadsheet format, exposure parameters, parameter default values and intake equations in the "Interim Final Policy and Guidance on Risk Assessments for Corrective Action at Resource Conservation and Recovery Act (RCRA) Facilities."

If you have any questions regarding this transmittal, please contact Mark Burmeister of my staff at extension 5891.

S. G. Stiger
Associate General Manager
Environmental Restoration Management

NSD:lmw

Orig. and 1 cc - J. M. Roberson

Attachment:
As Stated

cc:
M. H. McBride   - DOE, RFO
R. J. Schassburger -   "   "
M. N. Silverman   -   "   "
L. W. Smith   -   "   "

REVISED BOUNDING RISK ASSESSMENT FOR OPERABLE UNIT NO. 2 TREATABILITY SYSTEM SPILL

A revised risk assessment was performed on the small spill of water present in the Operable Unit No. 2 (OU 2) Treatability System. Instead of using chemical concentrations in water, the revised assessment is based on extrapolated chemical concentrations in soil, as requested by the Colorado Department of Health.

Attached are the computer spreadsheets for a screening-level assessment of human health risks. The spreadsheet format, exposure parameters, parameter default values and the intake equations follow the CDH Interim Final Guidance for risk assessments used to determine the need for a Corrective Measures Study (CMS) at a RCRA facility (CDH, 1993).

As shown in the lower right-hand corner of Table 2, the estimated upper-bound total added cancer risk from ingestion of soil, dermal contact with soil, and inhalation of soil particles by the future on-site resident at OU 2 is between 1E-7 and 1E-8, or an added cancer incidence between 1 in 10 million and 1 in 100 million. The risk screening threshold proposed by CDH for making a determination of need for a CMS is a cumulative risk of 1E-6. Thus, using the CDH screening-level risk assessment methodology, the small spill at OU 2 appears to present a potential cancer risk level at least one order of magnitude less than the CDH screening threshold.

As shown in the lower right-hand corner of Table 3, the estimated upper-bound total HQ (Hazard Quotient) for noncancer health effects is between 1E-02 and 1E-03, or between 0.1% and 1% of the cumulative risk screening threshold proposed by CDH (HQ=1). Thus, using the CDH methodology, the small spill at OU 2 appears to present a potential noncancer health risk level at least two orders of magnitude less than the CDH screening threshold.

Because measured soil concentrations of seven COCs (Chemicals of Concern) identified in the water spilled at the OU 2 Field Treatability Unit were unavailable, it was necessary to extrapolate maximum surface soil concentrations on the very conservative basis of 40% soil moisture at saturation; i.e., the measured water concentrations were multiplied by 0.4 to estimate maximum soil concentrations. A maximum soil moisture of 40% is generally typical of a moderately compacted soil; actual maximum soil moisture recorded at OU 2 is about 30%, with an average nearer to 20%, according to OU 2 records.

This specific application of CDH's proposed RCRA screening-level risk assessment methodology to a very small spill at OU 2 (viz., 10 gallons) appears to indicate no need for a CMS, at least on the basis of soil-related risks (CDH proposes that water will be screened on the basis of an ARAR rather than a risk level). Still, it appears that the risk levels projected using the CDH methodology can overstate the reasonable upper-bound risks by many orders of magnitude. As a means of supporting this conclusion, the exposure assessment scenario implicit in the CDH default exposure factors and intake questions is outlined in Attachment 2 as it applies to the 10-gallon spill at OU 2.

TABLE 1

RESIDENTIAL EXPOSURE QUANTIFICATION--Intake Calculation: OU-2 Spill at Field Treatability Unit

Max Concentration (Cmax) at SWMU or CAMU

Contaminant of Concern (COC)	cis-1,2 DCE	1,1 DCA	TCE	PCE
Modelled:				
Surface Soil (mg/kg) (1)	3.60E-03	3.20E-04	1.20E-03	8.00E-04
Airborne Soil Particulates (mg/m3) (2)	7.80E-07	6.40E-08	2.60E-07	1.70E-07
Indoor Airborne Soil VOCs (mg/m3)	NA	NA	NA	NA

Route of Exposure and Intake (Imax)

	cis-1,2 DCE		1,1 DCA		TCE		PCE	
	Noncarcinogen (NC)	Carcinogen (C)	Noncarcinogen (NC)	Carcinogen (C)	Noncarcinogen (NC)	Carcinogen (C)	Noncarcinogen (NC)	Carcinogen (C)
SOIL INGESTION:								
Child Intake (mg/kg-d) (3)(4)	4.60E-07	3.95E-08	4.09E-08	3.51E-09	1.53E-07	1.32E-08	1.02E-07	8.77E-09
Adult Intake (mg/kg-d) (5)(6)	4.93E-08	1.69E-08	4.38E-09	1.50E-09	1.64E-08	5.64E-09	1.10E-08	3.76E-09
TOTAL INTAKE	5.10E-07	5.64E-08	4.53E-08	5.01E-09	1.70E-07	1.88E-08	1.13E-07	1.25E-08
SOIL DERMAL CONTACT:								
Child Intake (mg/kg-d) (7)(8)	5.29E-06	4.54E-07	4.71E-07	4.03E-08	1.76E-06	1.51E-07	1.18E-06	1.01E-07
Adult Intake (mg/kg-d) (9)(10)	1.75E-06	6.00E-07	1.56E-07	5.34E-08	5.84E-07	2.00E-07	3.89E-07	1.33E-07
TOTAL INTAKE	7.04E-06	1.05E-06	6.26E-07	9.37E-08	2.35E-06	3.51E-07	1.57E-06	2.34E-07
SOIL PARTICLE INHALATION:								
Child Intake (mg/kg-d) (11)(12)	1.89E-15	1.62E-16	1.55E-16	1.33E-17	6.29E-16	5.39E-17	4.11E-16	3.52E-17
Adult Intake (mg/kg-d) (13)(14)	4.60E-16	1.58E-16	3.77E-17	1.29E-17	1.53E-16	5.25E-17	1.00E-16	3.44E-17
TOTAL INTAKE	2.35E-15	3.19E-16	1.93E-16	2.62E-17	7.82E-16	1.06E-16	5.11E-16	6.96E-17

Max Concentration (Cmax) at SWMU or CAMU

Contaminant of Concern (COC)

	Carbon Tet		Chloroform		Toluene	
Modelled:						
Surface Soil (mg/kg) (1)	1.20E-03	1.20E-03	2.80E-04	2.80E-04	1.60E-04	1.60E-04
Airborne Soil Particulates (mg/m3) (2)	2.60E-07	2.60E-07	6.00E-08	6.00E-08	3.50E-08	3.50E-08
Indoor Airborne Soil VOCs (mg/m3)	NA	NA	NA	NA	NA	NA

Route of Exposure and Intake (Imax)	Noncarcinogen (NC)	Carcinogen (C)	Noncarcinogen (NC)	Carcinogen (C)	Noncarcinogen (NC)	Carcinogen (C)
SOIL INGESTION:						
Child Intake (mg/kg-d) (3)(4)	1.53E-07	1.32E-08	3.58E-08	3.07E-09	2.05E-08	1.75E-09
Adult Intake (mg/kg-d) (5)(6)	1.64E-08	5.64E-09	3.84E-09	1.32E-09	2.19E-09	7.51E-10
TOTAL INTAKE	1.70E-07	1.88E-08	3.96E-08	4.38E-09	2.26E-08	2.50E-09
SOIL DERMAL CONTACT:						
Child Intake (mg/kg-d) (7)(8)	1.76E-06	1.51E-07	4.12E-07	3.53E-08	2.35E-07	2.02E-08
Adult Intake (mg/kg-d) (9)(10)	5.84E-07	2.00E-07	1.36E-07	4.67E-08	7.78E-08	2.67E-08
TOTAL INTAKE	2.35E-06	3.51E-07	5.48E-07	8.20E-08	3.13E-07	4.68E-08
SOIL PARTICLE INHALATION:						
Child Intake (mg/kg-d) (11)(12)	6.29E-16	5.39E-17	1.45E-16	1.24E-17	8.47E-17	7.26E-18
Adult Intake (mg/kg-d) (13)(14)	1.53E-16	5.25E-17	3.54E-17	1.21E-17	2.06E-17	7.07E-18
TOTAL INTAKE	7.82E-16	1.06E-16	1.81E-16	2.46E-17	1.05E-16	1.43E-17

Note: (1) Cmax (mg/kg) = Cmax (mg/L)*0.4 (40% soil moisture at saturation in moderately compacted soil).

Note: (2) Cmax (mg/m3) = Cmax (mg/kg)/4630 m3/mg (PEF, particulate emission factor from EPA RAGS, Part B).

Note: (3) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.3E-4 (CDH RCRA standard default intake factor).
(4) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.1E-5 (CDH).

Note: (5) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*1.4E-5 (CDH).
(6) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*4.7E-6 (CDH).

Note: (7) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.5E-3 (CDH).
(8) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.3E-4 (CDH).

Note: (9) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*4.9E-4 (CDH).
(10) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*1.7E-4 (CDH).

Note: (11) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.9E-15 (CDH).
(12) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.6E-16 (CDH).

Note: (13) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*4.6E-16 (CDH).
(14) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*1.6E-16 (CDH).

TABLE 2
RESIDENTIAL RISK CHARACTERIZATION--

Risk Calculation for Carcinogens: OU-2 Spill at Field Treatability Unit

Route of Exposure and Risk (Rmax)	Contaminant--Carcinogen						
	cis-1,2 DCE	1,1 DCA	TCE	PCE	Carbon Tet	Chloro-form	Toluene
SOIL INGESTION							
Total Intake (mg/kg-day)*	5.64E-08	5.01E-09	1.88E-08	1.25E-08	1.88E-08	4.38E-09	2.50E-09
Slope Factor (mg/kg-day)-1=	NA	NA	1.10E-02	5.20E-02	1.30E-01	6.10E-03	NA
Added Cancer Risk	NA	NA	2.07E-10	6.51E-10	2.44E-09	2.67E-11	NA
SOIL DERMAL CONTACT							
Total Intake (mg/kg-day)*	1.05E-06	9.37E-08	3.51E-07	2.34E-07	3.51E-07	8.20E-08	4.68E-08
Slope Factor (mg/kg-day)-1=	NA	NA	1.10E-02	5.20E-02	1.30E-01	6.10E-03	NA
Added Cancer Risk	NA	NA	3.86E-09	1.22E-08	4.57E-08	5.00E-10	NA
SOIL PARTICLE INHALATION							
Total Intake (mg/kg-day)*	3.19E-16	2.62E-17	1.06E-16	6.96E-17	1.06E-16	2.46E-17	1.43E-17
Slope Factor (mg/kg-day)-1=	NA	NA	6.00E-03	2.00E-03	5.30E-02	8.10E-02	NA
Added Cancer Risk	NA	NA	6.39E-19	1.39E-19	5.64E-18	1.99E-18	NA
Total Residential Contaminant--Specific Added Cancer Risk	NA	NA	4.07E-09	1.28E-08	4.81E-08	5.27E-10	NA
TOTAL RESIDENTIAL ADDED CANCER RISK							6.55E-08

TABLE 3
RESIDENTIAL RISK CHARACTERIZATION–
Risk Calculation for Noncarcinogens: OU-2 Spill at Field Treatability Unit

Route of Exposure and Risk (Rmax)	Contaminant--Noncarcinogen						
	cis-1,2 DCE	1,1 DCA	TCE	PCE	Carbon Tet	Chloroform	Toluene
SOIL INGESTION							
Total Intake (mg/kg-day)/	5.10E-07	4.53E-08	1.70E-07	1.13E-07	1.70E-07	3.96E-08	2.26E-08
Reference Dose (mg/kg-day)=	1.00E-02	1.00E-01	NA	1.00E-02	7.00E-04	1.00E-02	2.00E-01
Hazard Quotient	5.1E-05	4.53E-07	NA	1.13E-05	2.43E-04	3.96E-06	1.13E-07
SOIL DERMAL CONTACT							
Total Intake (mg/kg-day)/	7.04E-06	6.26E-07	2.35E-06	1.57E-06	2.35E-06	5.48E-07	3.13E-07
Reference Dose (mg/kg-day)=	1.00E-02	1.00E-01	NA	1.00E-02	7.00E-04	1.00E-02	2.00E-01
Hazard Quotient	7.04E-04	6.26E-06	NA	1.57E-04	3.35E-03	5.48E-05	1.57E-06
SOIL PARTICLE INHALATION							
Total Intake (mg/kg-day)/	2.35E-15	1.93E-16	7.82E-16	5.11E-16	7.82E-16	1.81E-16	1.05E-16
Reference Dose (mg/kg-day)=	NA	1.00E-01	NA	NA	NA	NA	NA
Hazard Quotient	NA	1.93E-15	NA	NA	NA	NA	NA
Total Residential Contaminant-Specific Hazard Quotient	7.55E-04	6.71E-06	NA	1.68E-04	3.60E-03	5.87E-05	1.68E-06

TOTAL RESIDENTIAL HAZARD QUOTIENT	4.59E-03

EXPOSURE ASSESSMENT SCENARIO
OU-2 TREATABILITY WATER SPILL

As the CDH methodology does not permit any soil chemical fate and transport assumptions or extrapolations, it is necessary to hypothesize steady-state conditions over 30 years. Within the upper surface soil horizon where the spill was assumed to saturate the pore space, there must be . . .

- No volatilization of the seven volatile chemicals contained in the spill water;

- No dilution from infiltration of rainwater and snowmelt;

- No leaching of these chemicals to lower soil strata;

- No chemical or biological degradation in the soil matrix; and

- No other form of attenuation can occur.

Since the seven volatile COCs are apt to volatilize rapidly and otherwise attenuate rapidly to near-zero concentrations in the confined source area of the spill, the potential exists for exaggeration of upper-bound risks by many orders of magnitude.

A 10-gallon spill can be assumed to infiltrate to saturation in the upper 6 inches of soil with a surface area of, perhaps, 6 or 7 sq ft, or <0.2% of the area of a quarter-acre residential lot on which a future 30-year resident can ingest soil, make dermal contact with soil, and inhale soil particles.

As to incidental soil ingestion, it is necessary under proposed CDH guidance to assume that a child will ingest soil at a near-maximum rate year-round over a 6-year period, then continue ingesting soil as an adult year-round over a 24-year period, without regard to weather, all the while confined to the tiny area of the spill. CDH makes no provision for the site-specific FI factor or the Fraction Ingested from the contaminated source area, which is a standard factor in EPA's intake equation for soil ingestion. The impact of these rules is, in this instance at OU-2, likely to result in several orders of magnitude of reasonable worst-case risk exaggeration.

Similarly, as to dermal contact with soil, it is necessary to assume that a 30-year resident will contact surface soil year-round at a near-maximum rate of soil adherence to skin, with the head, hands, arms, legs and feet of the child exposed year-round, and thereafter with the head, hands, arms and lower legs of the adult exposed year-round. EPA has specified that the dermal exposure frequency should account for local weather conditions (RAGS, 1989). The implausibility of CDH assumptions is compounded by the overriding assumption that all dermal contact will occur over 30 years within the 6 to 7-sq-ft area of the spill at OU-2. Accordingly, it is not surprising that projected dermal contact risk exceeds the soil ingestion risk by an order of magnitude, while it is typical that soil ingestion will contribute more risk than dermal contact.

Other assumptions affecting the inhalation risks are similarly implausible, but the relative risk contributed by the inhalation route of exposure adds virtually no risk to total cancer and noncancer risks.

A further concern is that CDH screening rules are applied to COCs in soil much more conservatively than to the same COCs in water. By screening the route of exposure to chemicals in drinking water using the most stringent water quality standards, the risk screening levels applied to soil can be orders of magnitude lower and more restrictive than the equivalent risk levels of water quality standards. For example, one COC in the water spilled at OU-2 was carbon tetrachloride, with a Primary MCL (Maximum Contaminant Level) of 5 ug/L. While the maximum reported level of carbon tetrachloride in water at the OU-2 Field Treatability Unit was 3 ug/L, the standardized cancer risk level at MCL is set at 1E-5, based only on ingestion of water combined with inhalation of water volatiles released in household use of water (EPA Region 10, 1991).

Thus, the CDH screening rules are applied to carbon tetrachloride in water much more liberally (1E-5, not including the cancer effects of six other COCs and not including the dermal contact route of exposure), as compared to that same COC in soil (1E-6, including the cancer effects of all seven COCs and all routes of exposure). At OU-2, the *sum* of COC cancer risks from seven COCs in soil and three routes of exposure to soil COCs must not exceed the 1E-6 threshold. These two cancer risk screening levels—1E-6 for summed risks in soil and 1E-5 just for one COC in water are many orders of magnitude apart and illustrate that water is to be screened much more liberally than soil.

Presumably, the default values and equations specified by CDH serve the purpose of screening the potential risks at the level of a reasonable worst case, i.e., the bounding risk estimate for the MEI (Maximally Exposed Individual). EPA Exposure Assessment Guidelines (1992) stipulate the only utility of the bounding risk estimate is to eliminate certain environmental pathways and routes of exposure from a full risk assessment, i.e., to identify the risk-driving pathways and routes that will require detailed assessment. EPA states that a bounding estimate "certainly cannot be used for an estimate of actual exposure (since by definition it is clearly outside the actual distribution)." The actual risk distribution would include the *average* intakes and risks, as well as those for RME or Reasonable Maximum Exposure.

Although the bounding risk estimate is useful for screening out environmental pathways and routes of exposure that contribute insignificantly to overall risks, it should rely on credible assumptions. As a test for reaching a decision on the need for corrective action at a RCRA facility, the bounding estimate appears highly inappropriate. Further, the practice of mixing water quality standards presenting highly variable risk levels with uniform risk-based soil screening criteria appears highly inconsistent.